MULTI-AXIS RESISTANCE EXERCISE DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on my provisional application No.60/441,708 filed on January 21, 2003 entitled "Multi-Axis Resistance Exercise Device," the full disclosure of which is incorporated by reference herein.

FIELD OF THE INVENTION

[0002] This invention is generally related to exercise devices for the upper torso of humans, and more particularly, to a weight resistance exercise machine for the muscles surrounding the shoulder joints of a user.

BACKGROUND OF THE INVENTION

[0003] The shoulder is the most mobile joint in the human body. It has 180 degrees of motion in abduction and forward flexion and 360 degrees of motion in circumduction. The shoulder is basically a ball-and-socket joint with three main bones: the upper arm bone (humerus), collarbone (clavicle), and shoulder blade (scapula). The collarbone is one of the main bones of the shoulder joint. The clavicle and acromioclavicular joint help increase the range of motion of the shoulder joint and increase the strength of the shoulder for movements above the shoulder level. The clavicle also protects nerves and blood vessels from the neck to the shoulder and gives the neck structure. The scapula or shoulder blade stabilizes the shoulder from the backside. These bones are held together by muscles, tendons, and ligaments.

[0004] The head of the humerus resembles a ball, which is seated in the glenoid fossa or cavity of the scapula. The structure of the shoulder ball and socket joint allows a wide range of movement of the arm in relation to the upper torso of the human body. The mobility is achieved by having fewer static restraints as compared to similar joints in other parts of a human body.

Having fewer restraints means less stability, so the shoulder also has the least static stability of any joint in the human body.

[0005] Whereas static stability is provided by bone and non-elastic soft tissues, dynamic stability is provided by elastic and contractile musculotendinous structures. Compensation for reduced static stability in the shoulder is accomplished with enhanced dynamic stability. Unlike static stabilizers, which can provide only endpoint restrains, musculotendinous structures surround the shoulder and provide dynamic restraint throughout the entire range of motion. Without dynamic restraints, the stability of the shoulder has been compared to the instability of a golf ball resting on a golf tee.

[0006] The greatest stability for the glenohumeral joint is provided by the muscle groups, which cross the shoulder joint and allow some of the movements. Strong muscles extending from the back of the scapula, in front of the joint, crossing the joint superiorly, and extending posterially of the joint form a protective cuff that holds the humerus to the glenoid fossa, strengthen the joint and resists possibly injurious movements of the humerus head in anterior, superior and posterior directions. Circumduction, or a movement of the shoulder joint allows the arm to move along the axis of circumduction or along a horizontal line in the frontal plane passing through both shoulder joints. The shoulder is also capable of moving through an infinite number of planes of motion, which are perpendicular to the arc of circumduction and which pass through and contain the axis of circumduction.

[0007] Flexion identifies a movement whereby the humerus is brought forward beside the thorax. Extension defines a position in which the humerus is returned from any position of flexion to the relaxed anatomic position. Abduction defines a motion wherein the humerus moves laterally away from the body. If the person swings his arm sideways, the abduction

allows the humerus to move upward as well as laterally and medially to an extended vertical position beside the head. Adduction defines the motion in which the humerus is returned to the side of the body from 180 degrees of abduction. When adduction is combined with partial flexion, the persons can move their arms in front of the torso and cross the arms. Rotation defines the motion of the shoulder body wherein the humerus turns medially or laterally. Rotation when combined with other movements produces a variety of motions to allow raising and lowering of the arms, flexion, and abduction.

[0008] Muscles surrounding the shoulder can be exercised to protect the shoulder joint and increase the strength in the upper torso area. To enhance strength through all planes of motion, one must strengthen the moving muscles in all planes of motion. The strengthening exercise requires resistance in any plane of motion of the joint through a full 360-degree arc. It is well known that by moving resistance in different planes of motion of a muscle, different planes of fibers are employed to move the resistance, stimulating maximum strength gains within the same specific plane of fibers and motion exercised. Conventional exercise machines allow motion of the shoulder joint by about 90 degrees. For such machines, the shoulder is positioned at 90 degrees of external rotation and 90 degrees of abduction. Such positions may result in injury of the shoulder joint, which may then require a medical intervention.

[0009] The present invention contemplates elimination of drawbacks associated with prior art exercise machines and provision of a multi-axis exercise machine for the upper torso that allows 360-degree motions of the shoulder joint through a weight-resistance exercise.

SUMMARY OF THE INVENTION

[0010] It is therefore an object of the present invention to provide an exercise machine for the upper torso and more specifically for the muscles surrounding the shoulder joint.

[0011] It is another object of the present invention to provide an exercise machine that allows the shoulder to move in a variety of axes to increase stability and strength of the shoulder joint.

[0012] These and other objects of the invention are achieved through a provision of an apparatus for exercising an upper torso of a user, which allows the user to move the arms and shoulder joints about multiple axes of rotation, flexion and abduction of the muscles. The exercise machine has an upright positionable on a stable supporting surface and a support body that carries handholds for engagement by the user's arms and hands. The handholds are detachably re-positionable n a guide plate, which extends above the handholds, and to which the upper ends of the handholds are securely attached. Resistance to the movement of the handholds is provided by a weight stack positioned in the upright and connected by a flexible link to a spool, which in turn is connected to a gear assembly.

[0013] The gear assembly is operationally connected to a distant pivot assembly and through an extendable arm, to a proximal pivot assembly. The upper ends of the handholds are connected to the proximal pivot assembly, allowing to transmit the weight resistance force to the handholds. During movement of the handholds, the axes of rotation of the handholds are always oriented parallel to each other and perpendicular to the arc of circumduction of the shoulder joints of the user. The rotational arcs of the exercise are perpendicular to a rotational plane of the exercise of the shoulder joints and to the plane of circumduction of the corresponding shoulder of the user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Reference will now be made to the drawings wherein like parts are designed by like numerals, and wherein Figure 1 is a perspective view of the multi-axis exercise machine in accordance with the present invention.

[0015] Figure 2 is a perspective view of the active portions of the exercise machine of the present invention.

[0016] Figure 3 is a perspective view of the active portion of the exercise machine of the present invention with the handlebars extended forward of the backseat of the user chair.

[0017] Figure 4 is a side view of the active portion of the exercise machine of the present invention with the handlebars in a position similar to the position in Figure 3.

[0018] Figure 5 is a perspective view of the active portion of the exercise machine of the present invention with the handholds upper ends moved behind the user station.

[0019] Figure 6 is a side view of the active portion exercise machine of the present invention showing the position of the handholds similar to the position in Figure 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Turning now to the drawings in more detail, numeral 10 designates the exercise machine in accordance with the present invention. The apparatus 10 comprises a base member 12 adapted to rest on a supporting surface, such as the floor of an exercise room. A vertical upright 14 is secured to the base member and extends upwardly therefrom to receive and enclose a portion of a weight resistance means, which includes a weight stack 16. The weight stack 16 is operationally connected through a flexible link to other parts of the weight resistance means through a gearbox and pivot assemblies, to a pair of handholds or handles 20, 22.

[0021] An optional stabilizing member 18 is securely attached transversely to the base member 12. The stabilizing member 18 comprises a cross bar 24 and an upwardly extending arc-shaped member 26, which is connected to a support body 28. The vertical upright 14 and the support body 28 form an enclosure for the majority of the moving parts of the exercise machine of the present invention, such as the lifting gear box, pivoting gearboxes, and the telescoping shaft, as will be described in more detail hereinafter.

[0022] Mounted on the base 12 is a user station 32, which comprises a chair support member 30, which is adapted to support a user chair 32 thereon. The chair 32 has a horizontal seat 34 and a vertical back 36 adapted to support a person in a sitting position for use of the apparatus of the present invention. The chair support member 30 is fixedly attached to the vertical upright 14 along a vertical side 38 thereof.

[0023] The support body 28 is comprised of a pair of parallel members 40, 42, each of which is attached along a respective vertical side 44 (for member 42) to the vertical upright 14. The support body 28 extends above the chair 32. An attachment plate 46 secured between the distal ends 48, 50 of the support members 40, 42, respectively. The attachment plate 46 engages the top portion of the stabilizing arc 26. The attachment plate 46 is provided with an opening through which a central top part 52 of the stabilizing arc 26 is inserted. In this manner, the stabilizing forces of the stabilizing member 18 are added to the stabilizing forces provided by the upright 14 and the base 12.

[0024] Turning now to the working or active portions of the exercise machine 10, with particular reference to Figures 2-6, the exercise machine 10 comprises a guide means 60 which is generally an arcuate plate extending above the user station 30 and having a front end 64 oriented along a plane generally forward of the user station and a back end 66 oriented along a plane

behind the user station 30. A detachably re-positionable carrying plate 61 is mounted on top of the guide plate 60. The carrying plate 61 has substantially the same radius of curvature as the guide plate 60. The carrying plate 61 can be secured at a plurality of locations along the length of the guide plate 60 depending on user's preference on the angle of rotation of the handholds 20, 22 in relation to a horizontal surface.

[0025] A pair of upwardly extending plates 68, 70 is detachably secured to the carrying plate 61.Pivotally secured between the plates 68 and 70 is a proximal pivot assembly 72. The proximal pivot assembly 72 is mounted for pivotal movement in relation to the plates 68 and 70. A distant pivot assembly 74 is connected to the proximate pivot assembly 72 by an extendable telescoping arm, or shaft 76.

[0026] An upper end of the handle 22 is secured in a cylindrical member 81, which in turn is attached to an attachment block 82; an upper end 84 of the handle 20 is similarly secured, through a cylindrical member 83 to an attachment block 86. The handholds are secured to the attachment blocks 82, 86 such that their axes of rotation are always parallel to each other and perpendicular to an arc of circumduction of the shoulder joints of a user seated in the user station 30. The handle 22 is provided with a handgrip 88; the handle 20 is provided with a handgrip 90. The handgrips 88 and 90 are rigid bars affixed to respective lower ends of the handles 20 and 22. The handles 20 and 22 can be optionally provided with cushioned arm engaging members 92 and 94, respectively.

[0027] The distant pivot assembly 74 is operationally connected to a lifting gearbox 100 through a connecting shaft 102. The distant pivot assembly 74 pivots about a pivot pin 104 extending through the unit 74 and engaged with an upright plate 106. A supporting plate 108 supports the lifting gearbox 100 and the upright plate 106. A plurality of pulleys 110 is mounted

behind the lifting gear box 100. A flexible link, such as for instance belt 112 extends between the pulleys 110 and the weight stack 16. The flexible link 112 wounds about a spool 188, a rotating shaft of which (not shown) is operationally connected to the shaft of the gear assembly 100. Tensioning of the belt 112 causes the weight stack 16 to be lifted, to some degree, and move the shaft 114 supporting the weight stack 16 within a weight stack sleeve 116.

[0028] In operation, the user is seated on the seat 34 with his legs on opposite sides of the chair seat 34. The user grasps the handgrips 88 and 90 such that the user's arms contact the cushioned arm supports 92 and 94. With the handle attachment blocks 82 and 86 in an uppermost position on the guide 60, such as shown in Figure 2, the user applies a squeezing force on the handles 20 and 22. The telescopic shaft 76 is extended fully in this position. Rotational force of to proximal pivot assembly 72. The pivotal motion of the handholds 20, 22 is resisted by the weight stack 16, causing the muscle fibers to grow and elongate. The rotational axis of the handholds 20, 22 is always perpendicular to the arc of circumduction of the user's shoulders joint, allowing a multi-axis movement of the shoulder joints.

[0029] To continue exercising the muscles at different angles and axes, the user repositions the carrying plate 61 with attachment blocks 82 and 86, to the back and down along the guide plate 60. The user secures the attachment blocks 82 and 86 in the newly selected position noting that the telescoping shaft 76 has been shortened. In the new position, the axes of rotation of the handholds 20, 22 are oriented at a different angle in relation to a horizontal plane. The user repeats the extension and squeezing motion on the handle 20 and 22, again acting against the resistance of the weight stack 16.

[0030] The lowermost position of the attachment blocks 82 and 86, as shown in Figures 5 and 6, places the handgrips 88 and 90 in an almost horizontal position. The attachment blocks

82 and 86 are secured adjacent the rearmost portion 66 of the guide plate 60 allowing the arms of the user to move in a plane, which is substantially different from a plane of movement when the attachment blocks 82 and 86 are positioned closer to the front end 64 of the guide plate 60.

[0031] The exercise machine of the present invention allows a multi-plane resistance exercise, training, rehabilitation, as well as strength testing of the shoulder joints of the user. Both anterior and exterior muscles of the human body surrounding the shoulder joints are forced to move through multiple stages of extension and abduction. The lifting gearbox can provide a number of resistance selections, such as step up, step down, 1:1 gear ratios.

[0032] The spool 118 mounted co-axially on the shaft of the gear assembly 100 transmits resistance to the gear assembly output shaft. The spool 118 converts the mass of the suspended weight stack 16 to resistance moment vector. The resistance force is then transferred to the resistance mechanism gear output shaft and from there - to a second shaft, which is the gear input shaft. The gear/weight stack assembly provides the necessary mass and resistance force to movement of the handles 20 and 22 allowing to strengthen the muscles surrounding the shoulder joint of the user.

[0033] Due to the uniform force created by the weight stack 16 on both handholds 20, 22, the movements of the handles 20 and 22 facilitate symmetrical exercise of both arms and muscle groups surrounding the shoulder joints. The axes of movement of the handholds 20, 22 are always parallel to each other, with the plane of the exercise always perpendicular to the arc of circumduction of the shoulders of the user. The centerline of each handle 20, 22 passes through the center of the corresponding glenohumeral joint, intercepting and perpendicular to the axis of circumduction of the shoulders.

[0035] The axes of the handholds define the rotational axis of exercise for the corresponding shoulder of the user. When the user moves the handles 20 and 22, revolving about the rotational axis of the exercise, and the handles move in an arc, which allows complete extension, abduction and rotation of each shoulder of the user. The opposite moments of force produced by the left and right handholds are uniformly transmitted to the telescoping arm and then to the distant pivot assembly and the lifting gearbox, in effect connecting the output of the proximal pivot assembly to the gear box input shaft in series. The user-created moment vector is opposite in direction to and maintained in a co-linear relationship with the resistance moment vector transmitted through the telescoping shaft. The telescoping shaft 76 has the capability of telescoping within itself or through gearing within the resistance gear assembly.

[0036] The chair seat 34 can be vertically adjusted to facilitate positioning of the shoulders and therefore the height of the axis of shoulder circumduction of the user at the most beneficial level. If desired, the guide plate 60 can be also adjustably secured on the upright 14 to lower or raise the arc and thereby accommodate the user in the best possible manner. The apparatus 10 provides a pre-determined resistance to muscle fibers of the shoulder during the exercise, as well as tangential resistance (isotonic resistance) or dynamic variable resistance through the full range of the arc motion of the exercise. If desired, the weight stack 16 may be substituted by any other desired form of resistance, for instance, magnetic mechanism and the like. The user may exercise or train both shoulders simultaneously or one shoulder if desired.

[0037] Many changes and modifications can be made with the design of the present invention without departing from the spirit thereof. I therefore pray that my rights to the present invention be limited only by the scope of the appended claims.